Scanning Our Past

Electrical Engineering Hall of Fame: John J. Carty

In 1917, the American Institute of Electrical Engineers (AIEE) awarded the Edison Medal to John J. Carty (Fig. 1). At the time, he was the chief engineer of the American Telephone and Telegraph Company (AT&T) and had just completed his term as president of the AIEE. During his long career of more than a half century in the telephone industry, Carty played a leading role in the professionalization of communication engineering and became a strong proponent of industrial research.

I. Born in Cambridge

Carty was born 14 April 1861 in Cambridge, MA. He attended a local prep school, but decided not to go to college due to a visual impairment. He was only 15 years old when Alexander Graham Bell (Fig. 2) demonstrated his telephone, and Carty began his career in telephony in 1879 as a telephone operator for a local Bell company. He soon was assigned to work on the installation and testing of telephone apparatus and transmission lines. He made his first technical contribution in 1880, when he employed a common-battery signaling system in a phone service provided to a local express wagon company. The common battery at a central office provided power to the customer's receiver when a switchhook was closed, and eliminated the need for a battery at each receiving telephone.

Carty made several other technical inventions during the 1880s. In January 1881, he carried out the first major demonstration of a two-wire metallic circuit on a line between Boston, MA, and Providence, RI. This was an alternative to a single wire with earth return, which continued to be used for several years in most installations due to a cost advantage. In 1885, he designed an improved "click circuit" so that customers would not hear the click which indicated a busy line to the operator at switchboards. In 1886, Carty received a patent on a circuit using "repeating coils" employed in "phantom circuits." The phantom circuit was an early multiplex arrangement which enabled two or more conversations to be carried by lines simultaneously. Carty's invention used coils instead of resistors to achieve the necessary balance between the main circuit and phantom circuit.

Fig. 1. John J. Carty (courtesy IEEE History Center, Piscataway, NJ).

II. Western Electric

In 1887, Carty moved to a new job in New York City with the Western Electric Company, a Bell subsidiary. He was assigned to oversee the installation of telephone cables in cities along the east coast. After about two years, he was selected to be chief engineer of the Metropolitan Telephone and Telegraph Company in New York, also a Bell subsidiary. In 1891, he received a patent on a high-impedance "bridging ringer" to be connected in parallel with a voice circuit. This invention greatly reduced the transmission loss caused by the series connected ringer circuit used previously. This was part of a central-office ringing circuit used to notify a customer of a call. Carty directed a series of experiments leading to the conclusion that much of the crosstalk and other interference on lines in close proximity was caused by electrostatic induction rather than electromagnetic induction. Subsequently, he received a patent on a transposition technique (Fig. 3) intended to eliminate or greatly diminish crosstalk. The technique adopted required the transposition of wires in a line at specified intervals.

Digital Object Identifier 10.1109/JPROC.2005.851508

0018-9219/$20.00 © 2005 IEEE

Fig. 2. Alexander Graham Bell (courtesy IEEE History Center, Piscataway, NJ).

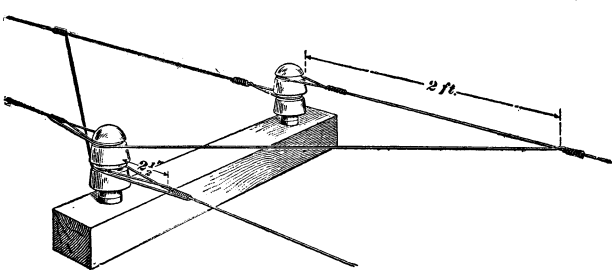

Fig. 3. Drawing of an approved method of making a telephone wire transposition, intended to eliminate or greatly diminish cross talk (courtesy IEEE History Center, Piscataway, NJ [from James E. Homans, *ABC of the Telephone* (New York: Audel & Co., 1904)]).

III. Linking Manhattan to Nob Hill

Theodore N. Vail, a strong advocate of universal and nationwide telephone service by the Bell System, became president of AT&T in 1907. He selected Carty as the new chief engineer of the company, and they presided over a major reorganization, which included the consolidation of most of the engineering research at a single location in New York City. Carty became the technical leader of an effort by AT&T to achieve transcontinental telephony, an effort which proved successful with the public demonstration of a wire circuit linking New York City and San Francisco, CA, in January 1915 (Fig. 4). The line employed approximately 130 000 poles (Fig. 5) and 2500 tons of copper. It employed loading coils at 8-mi intervals and also used three vacuum-tube repeater stations. By then, the company had initiated experiments with wireless telephony and, in October 1915, demonstrated voice transmission from a transmitter in Arlington, VA, to a receiver at the Eiffel Tower in Paris, France. The transmitter employed vacuum tubes and produced an output power of from 2 to 3 kW at a frequency of about 50 kHz.

Fig. 4. Surrounded by AT&T executives and invited guests, AT&T President Theodore N. Vail presides at the first transcontinental call, between New York City and San Francisco, in January 1915 (courtesy IEEE History Center, Piscataway, NJ).

Fig. 5. At the Nevada–Utah state line in late 1914 along the construction zone of the telephone circuit linking New York City and San Francisco (courtesy IEEE History Center, Piscataway, NJ).

In his AIEE presidential address presented in June 1916, Carty discussed the relationship between "pure science" and industrial scientific research. He observed that the current war in Europe was creating a "growing appreciation of the

importance of industrial scientific research, not only as an aid to military defense but as an essential party of every industry in time of peace." As an example, he cited the U.S. telephone industry, where cooperative research by "hundreds of scientists and engineers" had enabled achievements which "have so greatly exceeded those of other countries." He urged the AIEE and all its members to help educate manufacturers on the economic benefits of "industrial research conducted in accordance with scientific principles." He continued that industrial research, in contrast to purely scientific research, was "always conducted with the purpose of accomplishing some utilitarian end." He recommended that pure scientific research be done mainly at universities and technical schools, rather than in industrial laboratories, and that it be supported generously by industries and philanthropists.

During World War I, Carty received a commission as a major in the U.S. Army Signal Corps, later becoming a colonel, then a brigadier general. He served in France with responsibility for military communication and communication between Washington, DC, and the American expeditionary forces in Europe. After the war, he returned to his job as chief engineer of AT&T and also became a company vice-president. He became chairman of the board of the Bell Telephone Laboratories when it was founded in 1925. He was elected to the National Academy of Sciences and served on the National Research Council.

Carty died of complications from surgery on 27 December 1932 and was buried at Arlington National Cemetery.

JAMES E. BRITTAIN